Exercise	1	2	3	Total
100%	6	6	6	18
Points				

Extragalactic Astronomy and Cosmology

Homework 7 - Lecture 16 - single component Universe

Due date: October 31

1 Cosmic Neutrino Background

The predicted number of neutrinos in the Cosmic Neutrino Background is $n_\nu = \frac{3}{11}\, n_\gamma = 1.12 \times 10^8\,\mathrm{m}^{-3}$ for each of the three species of neutrino. About how many cosmic neutrinos are inside your body right now? What must be the sum of the neutrino masses, $m(\nu_e) + m(\nu_\mu) + m(\nu_\tau)$, in order for the density of the Cosmic Neutrino Background to be equal to the critical density, $\epsilon_{c,0}$?

2 Flat Universe containing matter and Λ

A Universe is spatially flat, and contains both matter and a cosmological constant (which is a rather good description of our Universe right now). For what value of $\Omega_m, 0$ is t_0 exactly equal to the Hubble time H_0^{-1}?

Hint: If you have problems with this exercise look into Ryden Section 6.2

3 Change of redshift in time

Assume a flat, matter-only Universe that has a Hubble constant of $H_0 = 70\,\mathrm{km\,s^{-1}\,Mpc^{-1}}$. You observe a galaxy with $z = 1$. How long will you have to keep observing the galaxy to see its redshift change by one part in 10^6 ? Can astronomers on Earth see the evolution of the Universe by studying changes in redshift?

Start with the following formula from the last homework:

$$\frac{dz}{dt_0} = H_0\,(1+z) \;-\; H_0\,(1+z)^{3(1+w)/2} \tag{1}$$

Hint: It is not necessary to integrate in this exercise but use a simple approach by answering the questions: What is Δz? And what is the value you are looking for?